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PATENT & TRADEMARK OFFICE

PATENT
Attorney Docket No.: 16869K-096700US
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:
SUSUMU SUZUKI et al.
Application No.: 10/684,210
Filed: October 10, 2003
For: METHOD FOR CONTROLLING STORAGE DEVICE CONTROLLER, STORAGE DEVICE CONTROLLER, AND PROGRAM
Customer No.: 20350

Examiner: Safet Metjahic
Technology Center/Art Unit: 2161
Confirmation No.: 2890

PETITION TO MAKE SPECIAL FOR NEW APPLICATION UNDER M.P.E.P. § 708.02, VIII & 37 C.F.R. § 1.102(d)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is a petition to make special the above-identified application under MPEP § 708.02, VIII & 37 C.F.R. § 1.102(d). The application has not received any examination by an Examiner.

(a) The Commissioner is authorized to charge the petition fee of $130 under 37 C.F.R. § 1.17(i) and any other fees associated with this paper to Deposit Account 20-1430.

(b) All the claims are believed to be directed to a single invention. If the Office determines that all the claims presented are not obviously directed to a single invention, then Applicants will make an election without traverse as a prerequisite to the grant of special status.

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(c) Pre-examination searches were made of U.S. issued patents, including a classification search, a computer database search, a keyword search, and a literature search. The searches were performed on or around March 14, 2005, and were conducted by a professional search firm, Kramer & Amado, P.C. The classification search covered Class 711 (subclasses 111, 153, and 154) for the U.S. and foreign subclasses identified above. The computer database search was conducted on the USPTO systems EAST and WEST. The keyword search was conducted in Class 707 (subclass 102) and Class 711 (subclasses 114, 161, 162, and 165). The literature search was conducted on the Internet and commercial databases for relevant non-patent documents.

(d) The following references, copies of which are attached herewith, are deemed most closely related to the subject matter encompassed by the claims:

(1) U.S. Patent No. 5,692,155;

(2) U.S. Patent No. 6,199,074 B1;

(3) U.S. Patent No. 6,647,474 B2;

(4) U.S. Patent No. 6,789,178 B2;

(5) U.S. Patent Publication No. 2002/0095489 A1;

(6) U.S. Patent Publication No. 2002/0129203 A1;

(7) D.L. Burkes et al., "Design Approaches for Real-Time Transaction Processing Remote Site Recovery;

(8) U.S. Patent No. 6,754,682 B1;

(9) U.S. Patent No. 6,370,626 B1; and

(10) U.S. Patent No. 6,308,284 B1.

(e) Set forth below is a detailed discussion of references which points out with particularity how the claimed subject matter is distinguishable over the references.

A. Claimed Embodiments of the Present Invention

The claimed embodiments relate to controlling a storage device controller to manage copies of data while keeping the consistency among the data stored in a plurality of storage volumes. A consistency group means a group of a plurality of storage volume pairs to be controlled so that the states of those pairs are changed to a "split" state together.

Independent claim 13 recites a storage system, comprising a plurality of storage regions which include a first group having a first plurality of storage regions and a second plurality of storage regions; a plurality of disk drive units having a plurality of disk drives which include the plurality of storage regions; and a controller configured to be coupled to an information processing device and to transfer data sent from the information processing device to the plurality of storage regions. The controller is configured to receive a split command sent to the first group; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status; write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions; and complete changing from the first status to the second status after writing data related to the write command to the first storage region. Consistency of data stored in the second plurality of storage regions in the second status is maintained.

Independent claim 24 recites a storage system, comprising a plurality of storage regions which include a consistency group having a first plurality of storage regions and a second plurality of storage regions, the consistency group being used to maintain consistency among data stored in the second plurality of storage regions; a plurality of disk drive units having a plurality of disk drives which include the plurality of storage regions; and a controller configured to be coupled to an information processing device and to transfer data sent from the information processing device to the plurality of storage regions. The controller is configured to receive a split command sent to the consistency group, the split command being used to split a relationship between the first plurality of storage regions and the second plurality of storage regions; start changing to a split status in which a relationship between the first plurality of storage regions and the second plurality of storage regions is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions after starting to change to the split status; be able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions after receiving the write command; and write data related to the write command to the first storage region after being able to copy data.

Independent claim 25 recites a storage system, comprising a plurality of storage regions which include a consistency group having a first plurality of storage regions and a second plurality of storage regions, in which a consistency among data stored in the second plurality of storage regions is maintained, if a relationship between the first plurality of storage regions and the second plurality of storage regions is split; a plurality of disk drive units having a plurality of disk drives which include the plurality of storage regions; and a controller configured to control transfer of data to the plurality of storage regions. The controller is configured to receive a split command sent to the consistency group, the split command being used to split a relationship between the first plurality of storage regions and the second plurality of storage regions; start changing to a split status in which the relationship between the first plurality of storage regions and the second plurality of storage regions is split; receive a write command sent to a first storage region of the first plurality of storage regions after starting to change to the split status; be able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions in accordance with the received write command; and write data related to the write command to the first storage region after being able to copy data.

Independent claim 26 recites a storage system, comprising a plurality of storage regions which include a consistency group in which a relationship between a first plurality of storage regions of the plurality of storage regions and a second plurality of storage regions related to the first plurality of storage regions is split based on a received split command, the split command being used to split the relationship between the first plurality of storage regions and the second plurality of storage regions; a plurality of disk drive units having a plurality of disk drives which include the plurality of storage regions; and a controller configured to control transfer of data to the plurality of storage regions. The controller is configured to receive the split command sent to the consistency group; start changing to a split status in which the relationship between the first plurality of storage regions and the second plurality of storage regions is split; receive a write command sent to a first storage region of the first plurality of storage regions after starting to change to the split status; copy data stored in the first storage region to a second storage region of the second plurality of storage regions in accordance with the received write command; and write data related to the write command to the first storage region after copying the data.

One of the benefits that may be derived is that it is possible to ensure the synchronism among the state changes of pairs in a consistency group to the split state.

B. Discussion of the References

None of the references discloses a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

For instance, claim 13 recites a controller configured to receive a split command sent to the first group; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status; write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions; and complete changing from the first status to the second status after writing data related to the write command to the first storage region, wherein consistency of data stored in the second plurality of storage regions in the second status is maintained.

Claim 24 recites a controller configured to receive a split command sent to the consistency group, the split command being used to split a relationship between the first plurality of storage regions and the second plurality of storage regions; start changing to a split status in which a relationship between the first plurality of storage regions and the second plurality of storage regions is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions after starting to change to the split status; be able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions after receiving the write command; and write data related to the write command to the first storage region after being able to copy data.

Claim 25 recites a controller configured to receive a split command sent to the consistency group, the split command being used to split a relationship between the first plurality of storage regions and the second plurality of storage regions; start changing to a split status in which the relationship between the first plurality of storage regions and the second plurality of storage regions is split; receive a write command sent to a first storage region of the first plurality of storage regions after starting to change to the split status; be able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions in accordance with the received write command; and write data related to the write command to the first storage region after being able to copy data.

Claim 26 recites a controller configured to receive the split command sent to the consistency group; start changing to a split status in which the relationship between the first plurality of storage regions and the second plurality of storage regions is split; receive a write command sent to a first storage region of the first plurality of storage regions after starting to change to the split status; copy data stored in the first storage region to a second storage region of the second plurality of storage regions in accordance with the received write command; and write data related to the write command to the first storage region after copying the data.

1. U.S. Patent No. 5,692,155

Iskiyan et al. relates to a method and apparatus for suspending multiple duplex pairs during backup of storage devices. FIG. 1 illustrates a primary storage controller 3 communicating with a secondary storage controller 6 via multiple peer-to-peer links 8. See col. 3, lines 31-64. The purpose is to provide a data processing system capable of both dual copy and remote dual copy for disaster recovery. See col. 10, lines 41-43. FIG. 6 illustrates a method for suspending multiple duplex pairs such that the data on the secondary devices remains synchronized in a sequence consistent order. See col. 11, lines 62-67. If a duplex pair is suspended with change recording, records written to a primary DASD (data access storage device) during suspension will be copied to the secondary duplex pair after the duplex pair is reestablished. See col. 12, lines 31-34.

As understood, Iskiyan et al. does not respond to a split command to manage data between duplex pairs. Accordingly, Iskiyan et al. does not teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

2. U.S. Patent No. 6,199,074 B1

Kern et al. relates to a database backup system ensuring consistency between primary and mirrored backup database copies despite backup interruption. FIG. 2 illustrates one or more primary controllers each having a data storage unit with multiple primary data storage devices. See generally col. 6, line 64 to col. 7, line 2. Multiple secondary controllers each have multiple associated secondary data storage devices, each secondary controller being coupled to one primary controller. See col. 5, lines 15-40. FIG. 5 illustrates in step 504, detection of a suspending condition. A suspending condition comprises an interruption in the storage of backup data, and in step 506, the host 202 identifies the primary devices affected by the suspending condition. See col. 8, line 66 to col. 9, line 4. The affected devices include any devices containing data from the primary database(s) impacted by the suspending condition. See col. 9, line 44 to col. 10, line 2.

As understood, Kern et al. does not manage consistency of pairs in accordance with a split command received by a controller. Thus, Kern et al. does not teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

3. U.S. Patent No. 6,647,474 B2

Yanai et al. relates to remote data mirroring system using local and remote write pending indicators. FIG. 1 illustrates a primary data storage system 14 including a primary data storage system controller 16 which receives data from the host 12 over data signal path 18. The primary data storage system controller 16 is also coupled to a storage device 20 which may include a plurality of data storage devices. See col. 4, lines 11-20. The data storage system 14 controls the transfer or copying of data from a primary data storage system to the secondary data storage system, independent of and without intervention from one or more host computers. See col. 7, lines 16-34. Once the secondary data storage system has written the data to the secondary data storage device, a secondary data storage write pending indicator bit 106 will be reset. See col. 7, lines 56-67.

As understood, the storage pending indicator bit of Yanai et al. does not manage consistency of pairs in accordance with a split command received by a controller. Thus, Yanai et al. does not teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

4. U.S. Patent No. 6,789,178 B2

Mikkelsen et al. relates to a remote data copy function using a prospective suspend command. FIG. 2A illustrates a computer system operating in a suspended mode, in which information is not transmitted from primary controller CNTL- 1 to secondary controller CNTL- 2, to thereby keep the remote copy on secondary data recording devices DASD- 2 in synchronization. See col. 7, lines 40-56. The use of prospective suspend permits a system to obtain a consistent remote copy for information recorded on any number of primary data recording devices DASD-1 that are controlled by a number of primary controllers CNTL-1. See col. 8, lines 35-41. The primary controller CNTL- 1 responds to each write command received from computer HOST by causing primary data recording device DASD-1 to update recorded information by storing information in information storage device STORE that indicates the information affected by each write command received while in the suspended mode. See col. 9, lines 40-65.

As understood, the prospective suspend command of Mikkelsen et al. does not change a first status to a second status in which a relationship between first and second storage regions is split. Thus, Mikkelsen et al. does not teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status);

and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

5. U.S. Patent Publication No. 2002/0095489 A1

Yamagami relates to a failure notification method and system using remote mirroring for clustering systems. FIG. 1 illustrates a system 50 including primary group 130a (production host) and secondary group 130b (remote host). See paragraph [0031]. Each host runs its own application. See paragraph [0041]. One host in a primary group is a master host and one host in a secondary group is a master host. See paragraph [0042]. If failure occurs in the production side, then secondary hosts perform the operation. See paragraph [0058]. Mirrored volumes for production data are manually broken using a break (split) command for purposes of backup. See paragraph [0059]. The split command would prevent a heartbeat PVOL 111a from sending signals between remote mirrors (e.g., 111 and 112). See paragraph [0060]. FIG. 2 illustrates a heartbeat status table 250 that indicates which of the hosts is a master host. See paragraph [0063].

As understood, the split command of Yamagami is manually operated and therefore is not processed by a controller for changing from a first status to a second status. Yamagami fails to teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

6. U.S. Patent Publication No. 2002/0129203 A1

Gagne et al. relates to data processing method and apparatus for independent access to replicated data. FIG. 1 illustrates data processing system 20 in which a multiprocessor host array 21 with one or more host devices controls operations. See generally paragraph [0029]. A standard device is considered logical volume 31, while a BCV(1) device and a BCV(2) device refers to logical volumes 33 and 35 respectively. See paragraph [0033]. A test determines if a BCV device is in synchronism with a standard device. If an error condition exists, the step is diverted, or else a split request blocks further communications to the device adapters from other hosts. See paragraph [0051]. The operation of new write requests is prevented for a selected split command or request. See paragraph [0052].

As understood, the split command of Gagne et al. merely prevents writing of data from the host level, not at the controller level. Gagne et al. fails to teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

7. D.L. Burkes et al., "Design Approaches for Real-Time Transaction Processing Remote Site Recovery

Burkes et al. relates to real-time transaction processing in remote site recovery. Burkes et al. recognizes attributes of an acceptable design approach to be the provision of remote recovery with support of continuous operations. See page 568, col. 2. FIG. 2 illustrates a active system and a tracking system (remote site), which allows a user to select insurance levels for recovery of resources. The user, a host computer connected to the systems by CCUs, is allowed to control service loss exposure by selecting a lifeboat readiness level. See page 571, col. 2.

As understood, the lifeboat readiness level of Burkes et al. does not provide for control processes of a split command by a controller. Thus, Burkes et al. does not teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

8. U.S. Patent No. 6,754,682 B1

LeCrone et al. discloses a method and an apparatus for enhancing data recovery in data processing systems in which applications span multiple logical devices. A data processing system includes multiple standard devices (40, 41, 42) for storing data and corresponding BCV devices (43, 44, 45) for, in one mode, operating as mirrors of those standard devices. If certain of those BCV devices are associated with the same data set, a CONSISTENT SPLIT operation controls the way in which each of these BCV devices is detached from its corresponding standard device and made available to another application (step 100 in FIG. 5). Each command to an application for controlling the BCV devices is translated into one or more request data structures that identify the BCV devices as being involved in a consistent split operation (SPLIT CONSISTENT flag 101) and that establishes a system lock out for those particular devices during which those devices are split from their respective devices in a consistent manner (see, e.g., steps 130 and 145 in FIG. 7, step 171 in FIG. 8, and step 191 in FIG. 9).

As understood, LeCrone et al. does not teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

9. U.S. Patent No. 6,370,626 B1

Gagne et al. discloses a method and an apparatus for enabling a common data set to be utilized by multiple data processes. During a first operating mode, first and second data stores (34, 36 in FIG. 1) in a data storage facility with a common buffer attach to a first data process and act as mirrors. See col. 6, lines 17-31. Data to be written transfers to the common buffer and then to the data stores. A second command produces a split (step 150 in FIG. 4) whereby the first data store remains attached to the first data process and the second data store is available to the second data process. After the second command is executed, any data in the common buffer is transferred to the corresponding data stores in parallel with and transparently to the actions between the first and second data processes and the first and second data stores, respectively. See col. 7, lines 41-67.

As understood, Gagne et al. does not teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

10. U.S. Patent No. 6,308,284 B1

LeCrone et al. discloses a method and an apparatus for assuring data consistency in a data processing network including local and remote data storage controllers interconnected by independent communication paths. The remote storage controller or controllers (34, 37) normally act as a mirror for the local storage controller or controllers (32). See FIG. 2; col. 6, lines 29-46.. If, for any reason, transfers over one of the independent communication paths (35, 36) is interrupted, transfers over all the independent communication paths to predefined devices in a group are suspended thereby assuring the consistency of the data at the remote storage controller or controllers. See col. 6, line 61 to col. 7, line 7; col. 3, lines 45-53. In FIG. 6, when a consistency group is enabled in step 84, unit check modules, such as unit check modules 90 and 91 in FIG. 1, are also enabled to monitor communications path status during each input/output request. When the cause of the interruption has been corrected, the local storage controllers are able to transfer data modified since the suspension occurred to their corresponding remote storage controllers thereby to reestablish synchronism and consistency for the entire dataset. See col. 13, line 54 to col. 14, line 3.

As understood, LeCrone et al. discloses suspending data transfer. It fails to teach a controller configured to receive a split command sent to a group of storage regions (first group or consistency group) which includes a first plurality of storage regions and a second plurality of storage regions; start, in accordance with the split command, changing from a first status to a second status in which a relationship between the first plurality of storage regions and a second plurality of storage regions related to the first group is split; receive a write command sent from the information processing device to a first storage region of the first plurality of storage regions during a period of changing from the first status to the second status (i.e., to the split status); and write data related to the write command to the first storage region after being able to copy data stored in the first storage region to a second storage region of the second plurality of storage regions, as recited in independent claims 13, 24, 25, and 26.

(f) In view of this petition, the Examiner is respectfully requested to issue a first Office Action at an early date.

Respectfully submitted,

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